Artificial Blood

*Dr. Ranjan Singh**

Artiflcial Blood

Artificial blood is now so much a science fiction. The saga of artificial blood now has gone from coffee room discussion to clinical use.

Artificial blood; The oxygen carrying blood substitutes has received a lot of attention recently because of the clinical use of some of flurocarbons and the development of stromafree haemoglobin solution. The practical advantage of having oxygen carrying blood solutions which are nonatigenic (so no need of group typing or crossmatching) which are free of disease and which are readily transportable and can be stored easily having no problem of disease and which are readily transportable and can be stored easily having no problem of hypekalemia are evident. They will also have special importance.

a) When blood should not or cannot be used due to the nature of the patient b) In circumstances where a blood free oxygen carrying blood preparation has certain advantages over blood. c) When blood is unavailable.

Though fresh red cells will remain indispensable for long term replacement, some properties of oxygen carrying blood may exceed the therapeutic capability of red cell. Currently stroma free haemoglobin (SFH) solution and flurocarbon (FC) are the two potential oxygen carrying blood (OCB) substitutes available.

Haemoglobin

Outdated human red cells are the sources material for SFH. For transient oxygen

*M.D. (Medicine) M. Med (Haematology) F.I.C.A.
Director, Blood Transfusion Service.

transport assistance SFH could be used inspite of its very short circulatory half life i. e. 3-4 hrs. This solution is apparently not acutely toxic to kidney or other organ. Haemoglobin readily loads oxygen in animals breathing air but does not adequeatly unload oxygen to tissue (because of absence of disphosphoglycerate).

Flurocarbons

These compounds are water insoluble, have high solubility for gases and have very low surface tension. They carry oxygen entirely in emulsion form as physicaliy dissolved gas. FC are retained in circulation for 3-4 days. Flurocarbon, were used originally to demonstrate that total blood replacement with these compounds could be achieved and such naturalblood less animal having artificial environment can survive. Presently for clinical use the product. Fluosol DA 20% (Japan) is available.

Uses

Artificial blood can easily be transported and used for transfusion in any person regardless of blood group at the site of a great catastrophe.

The principle use of SFH will be in emergency situation where a large blood loss occurred. Another use would be in surgical procedures with extracorporial circulation where large volume is needed for short time to fill the system. In such procedures, the SFH have the advantage that they are not affected by the mechanical pumping, where erythrocytes are damaged. Besides, one might envisage an infusion or perfusion treatment with haemoglobin solution in the field of medicine e.g. in myocardial infraction.

There are many situationo in which the FC may be particularly useful. Some patients with chronic disease (e.g. thalassemia) who have had many blood transfusion may not be able to accept further blood because of serious iron overload. In these patients FC solution but not SFH might be especially useful. The emulsion of FC might also be very useful in the treatment of acute poisoning by carbonmonoxide. Specific FC emulsion will be designed for the treatment of coronary ischemia and storke. Recently experiments have shown that in the ischemic zone following ligation of the coronary artery in the dog, the volume of tissue infarcted was reduced by 30% after the treatment with FC because these preparations being cell free have better access to hypoxic areas than red cell themselves.

O.C.B. substitutes as presently formulated have an effective time in circulation of hours rather than days. This porperty would appear to limit their use to short term

support for patients with an urgent requirement for improved oxygen carrying capacity.

In the case of FC, currently used in man the recipient must inspire 95—100% oxygen in order to deliver sufficient oxygen to the tissue. The longterm adverse pulmonary effects of inspiring high concentrations of oxygen (oxygen toxicity) must be considered.

Both SFH and FC are cleared by reticuloendothelial system. Repeated use of the blood substitute may cause sturation of RE system and finally blockade leading patients suseptible to serious infetious diseases.

The current evidence suggest that OCB substitutes are efficacaious but longterm toxic affect of the both product in current state is still to be evaluated. Halogenated hydrocarbons have not been accepted open heartedly in most biological system todate.

In Summary, there is a great potential of both FC and SFH as blood substitutes. Since research in this area is active there are indications that the limitations outlined may be removed by developing modified and improved preperation. Another problem may be the cost of the product. Thus whereas the immediate clinical use of available blood subtitutes appears limited, future use may be more promising. The future of OCB has barely begun and it look as if artificial blood is round the corner.

Finally, I do not believe that the use of OCB will have a major impact on the activity of blood services. SFH is prepared from outdated human red cells which indicates improved utilization of blood donation. The need for blood bank will not disappear and OCB will be an additional entry into the field of blood banking

REFERENCES

1, Amberson W. R. — Blood substitutes, Biol Rev. 12:48(1937

2, Devenuto F. Fridman — Haemoglobulin solution as blood substitute, Surg Gyned Obst 149:417 (1937)

3 De Venuto F— Preperation and evaluation of haemoglobulin solution, prit Care Med 10:238(1981)

4. Djordjevich L, Milleri —Synthetic erythrocyte from lipid encapsulated haemoglobin Fxp. Haem. 8.584(1980)

5. Frank De Vento — Modified haemoglobin solution Vox Sang 44.129 (1983)

6. Greenbure A, Scooley M — Improved retention of SFH. J. Trauma 17:501 (1977)

7. Messmer K, Jesch F — Oxygen supply by stroma free haemoglobin Prog Clin, Bio, Red 19:175 (1978)

8. Tamm Jwo — Chemical modification of haemoglocin. Compar Biochem Phys 69:99 (1981).